

It forms soluble green crystals that explode with a green flame.

Fulminating Mercury.—Take mercury, 100 parts; nitric acid (specific gravity, 1.4), 1,000 parts (or 740 parts, by measure). Dissolve by a gentle heat, and when the solution has acquired the temperature of 130° F., slowly pour it through a glass funnel tube into alcohol (specific gravity, .830), 830 parts (or 1,000 parts, by measure). As soon as the effervescence is over, and white fumes cease to be evolved, filter through double paper, wash with cold water, and dry by steam (not hotter than 212° F.) or hot water. The fulminate is then to be packed in 100-grain paper parcels, and these stored in a tight box or corked bottle. Product 130 per cent of the weight of mercury employed.

Fulminating Powder.—I.—Niter, 3 parts; carbonate of potash (dry), 2 parts; flowers of sulphur, 1 part; reduce them separately to fine powder, before mixing them. A little of this compound (20 to 30 grains), slowly heated on a shovel over the fire, first fuses and becomes brown, and then explodes with a deafening report.

II.—Sulphur, 1 part; chlorate of potassa, 3 parts. When triturated, with strong pressure, in a marble or wedgwood-ware mortar, it produces a series of loud reports. It also fulminates by percussion.

III.—Chlorate of potassa, 6 parts; pure lampblack, 4 parts; sulphur, 1 part. A little placed on an anvil detonates with a loud report when struck with a hammer.

EXPOSURES IN PHOTOGRAPHING:
See Photography.

EXTRACTS:
See Essences and Extracts.

EXTRACTS, TESTS FOR:
See Foods.

EYE LOTIONS:

"Black Eye" Lotion.—"Black eyes" or other temporary discolorations of the skin may be disguised by the application of pink grease paint, or collodion colored by means of a little carmine. As lotions the following have been recommended:

I.—Ammonium chloride 1 part
Alcohol 1 part
Water 10 parts

Diluted acetic acid may be substituted for half of the water, and the alcohol

may be replaced by tincture of arnica, with advantage.

II.—Potassium nitrate . . . 15 grains
Ammonium chloride 30 grains
Aromatic vinegar 4 drachms
Water to make 8 ounces.

III.—The following is to be applied with camel's-hair pencil every 1, 2, or 3 hours. Be careful not to get it in the eyes, as it smarts. It will remove the black discoloration overnight:

Oxalic acid 15 grains
Distilled water 1 ounce

Foreign Matter in the Eye.—If a piece of iron or other foreign matter in the eye irritates it, and there is no way of removing it until morning, take a raw Irish potato, grate it, and use as a poultice on the eye. It will ease the eye so one can sleep, and sometimes draws the piece out.

Drops of Lime in the Eye.—If lime has dropped in the eye, the pouring-in of or the wiping-out with a few drops of oil is the best remedy, as the causticity of the lime is arrested thereby. Poppy-seed oil or olive oil is prescribed, but pure linseed oil ought to render the same service, as it is also used in the household. Subsequently, the eye may be rinsed out with syrup, as the saccharine substance will harden any remaining particles of lime and destroy all causticity entirely.

FABRIC CLEANERS:

See Cleaning Preparations and Methods and also Household Formulas.

FABRICS, WATERPROOFING OF:

See Waterproofing.

FACE BLACK AND FACE POWDER:
See Cosmetics.

Fats

Bear Fat.—Fresh bears' fat is white and very similar to lard in appearance. The flank fat is softer and more transparent than the kidney fat, and its odor recalls that of fresh bacon. Bears' fat differs from the fats of the dog, fox, and cat in having a lower specific gravity, a very low melting point, and a fairly high iodine value.

Bleaching Bone Fat.—Bone fat, which is principally obtained from horse bones, is very dark colored in the crude state, and of an extremely disagreeable smell. To remedy these defects it may be bleached by the air or chemicals, the former method only giving good results

when the fat has been recovered by means of steam. It consists in cutting up the fat into small fragments and exposing it to the air for several days, the mass being turned over at intervals with a shovel. When sufficiently bleached in this manner, the fat is boiled with half its own weight of water, which done, about 3 or 4 per cent of salt is added, and the whole is boiled over again. This treatment, which takes 2 or 3 weeks, sweetens the fat, makes it of the consistency of butter, and reduces the color to a pale yellow. Light seems to play no part in the operation, the change being effected solely by the oxygen of the air. The chemical treatment has the advantage of being more rapid, sufficient decoloration being produced in a few hours. The fat, which should be free from gelatin, phosphate of lime, and water, is placed in an iron pan along with an equal weight of brine of 14° to 15° Bé. strength, with which it is boiled for 3 hours and left to rest overnight. Next day the fat is drawn off into a wooden vessel, where it is treated by degrees with a mixture of 2 parts of potassium bichromate, dissolved in 6 of boiling water, and 8 parts of hydrochloric acid (density 22° Bé.), this quantity being sufficient for 400 parts of fat. Decoloration proceeds gradually, and when complete the fat is washed with hot water.

Bleaching Tallows and Fats.—Instead of exposing to the sun, which is always attended with danger of rendering fats rancid, it is better to liquefy these at a gentle heat, and then add $\frac{1}{2}$ in weight of a mixture of equal parts of kaolin and water. The fatty matter should be worked up for a time and then left to separate. Kaolin has the advantage of cheapness in price and of being readily procured.

Freshly burned animal charcoal would perhaps be a more satisfactory decolorizer than kaolin, but it is more expensive to start with, and not so easy to regenerate.

Exposure of tallow to the action of steam under high pressure (a temperature of 250° or 260° F.) is also said to render it whiter and harder.

Coloring Matter in Fats.—A simple method for the detection of the addition of coloring matter to fats is here described. Ten parts, by measure, of the melted fat are put into a small separating funnel and dissolved in 10 parts, by measure, of petroleum ether. The solution is then treated with 15 parts, by measure,

of glacial acetic acid and the whole shaken thoroughly. The addition of coloring matter is known by the red or yellow coloration which appears in the lower layer of acetic acid after the contents of the funnel have been allowed to settle. If only a slight addition of coloring matter is suspected, the acetic acid solution is run off into a porcelain basin and the latter heated on a water bath, when the coloration will be seen more readily. This test is intended for butter and margarine, but is also suitable for tallow, lard, etc.

Fatty Acid Fermentation Process.—The production of fatty acids from fats and oils by fermentation is growing in importance. These particulars, which are the actual results from recent experiments on a somewhat extended scale, are given: Seven hundred and fifty pounds of cottonseed oil are mixed with 45 gallons of water and 3 $\frac{1}{2}$ pounds of acetic acid; this mixture is heated to a temperature of 85° F. Castor-oil seeds, 53 pounds, decorticated and ground, are mixed thoroughly with 3 gallons of water and 4 $\frac{1}{2}$ gallons of the oil, and this mixture is stirred into the oil and water; the whole mass is then kept mixed for 12 hours by blowing air through, after which it is allowed to stand for another 12 hours, being given a gentle stir by hand at the end of every hour. After 24 hours the mass is heated to a temperature of 180° F., which stops the fermentation and at the same time allows the fatty acids to separate more freely. To assist in this effect there is added 1 gallon of sulphuric acid (1 in 3) solution.

After 2 hours' standing, the mass will have separated into three layers—fatty acids on the top, glycerine water below, and a middle, undefined layer. The glycerine water is run away, and the whole mass left to stand for 2 hours. The middle portion is run off from the separated fatty acids into another vessel, where it is mixed with 10 gallons of hot water, thoroughly stirred, and allowed to stand for 16 hours or more. The watery layer at the bottom, which contains some glycerine, is then run off, while the residue is mixed with a further quantity of 10 gallons of water, and again allowed to stand. The water which separates out, also the layer of fatty acids that forms on the top, are run off and mixed with the portions previously obtained. The various glycerine waters are treated to recover the glycerine, while the fatty acids are made marketable in any convenient way.

Preservation of Fats.—To produce fats and oils containing both iodine and sulphur, whereby they are preserved from going rancid, and consequently can be utilized to more advantage for the usual purposes, such as the manufacture of soaps, candles, etc., following is the Loebell method:

The essential feature of the process is that the iodine is not merely held in solution by the oil or fat, but enters into chemical combination with the same; the sulphur also combines chemically with the oil or fat, and from their reactions the preserving properties are derived.

The process consists of heating, for example, 6 parts of oil with 1 part of sulphur to a temperature varying between 300° and 400° F., then, when at about 195° F., a solution of iodine and oil is added to the mixture, which is constantly agitated until cool to prevent lumps forming. A product is thus obtained which acquires the consistency of butter, and contains both iodine and sulphur in combination.

Purifying Oils and Fats.—In purifying fatty oils and fats for edible purposes the chief thing is to remove the free fatty acids, which is done by the aid of solutions of alkalies and alkaline earths. The subsequent precipitation of the resulting soapy emulsions, especially when lime is used, entails prolonged heating to temperatures sometimes as high as the boiling point of water. Furthermore, the amount of alkalies taken is always greater than is chemically necessary, the consequence being that some of the organic substances present are attacked, and malodorous products are formed, a condition necessitating the employment of animal charcoal, etc., as deodorizer.

To prevent the formation of these untoward products, which must injuriously affect the quality of edible oils, C. Fresenius proposes to accelerate the dispersion of the said emulsions by subjecting the mixtures to an excess pressure of 1 to 1½ atmospheres and a corresponding temperature of about 220° F., for a short time, the formation of decomposition products, and any injurious influence on the taste and smell of the substance being prevented by the addition of fresh charcoal, etc., beforehand. Charcoal may, and must in certain cases, be replaced for this purpose by infusorial earth or fuller's earth. When this process is applied to cottonseed oil, 100 parts of the oil are mixed with $\frac{1}{10}$ part of fresh, pure charcoal, and $\frac{1}{2}$ part of pure fuller's earth.

The mixture is next neutralized with lime-water, and placed in an autoclave, where it is kept for an hour under pressure, and at a temperature of 220° F. Under these conditions the emulsion soon separates, and when this is accomplished the whole is left to cool down in a closed vessel.

FATS, DECOMPOSITION OF:

See Oil.

FEATHER BLEACHING AND COLORING:

See also Dyes.

Bleaching and Coloring Feathers.—Feathers, in their natural state, are not adapted to undergo the processes of dyeing and bleaching; they must be prepared by removing their oil and dirt. This is usually done by washing them in moderately warm soap and water, and rinsing in warm and cold water; or the oil may be chemically removed by the use of benzine. To remove it entirely, the feathers must be left in the cleansing fluid from a half hour to an hour, when they may be subjected to the process of bleaching.

Bleaching Plumes.—Plumes may be almost entirely bleached by the use of hydrogen peroxide, without injuring their texture.

In specially constructed glass troughs, made the length of an average ostrich feather, 15 or 20 of these feathers can be treated at a time. The bleaching fluid is made from a 30 per cent solution of hydrogen peroxide, with enough ammonia added to make it neutral; in other words when neutral, blue litmus paper will not turn red, and red will take a pale violet tinge. The previously cleansed feathers are entirely immersed in this bleaching bath, which may be diluted if desired. The trough is covered with a glass plate and put in a dark place. From time to time the feathers are stirred and turned, adding more hydrogen peroxide. This process requires 10 to 12 hours and if necessary should be repeated. After bleaching they are rinsed in distilled water or rain water, dried in the air, and kept in motion while drying.

To insure success in coloring feathers in delicate tints, they must be free from all impurities, and evenly white. It has been found of advantage to rub the quill of heavy ostrich plumes while still moist with carbonate of ammonia before the dyeing is begun.

Methods of Dyeing Feathers.—I.—A boiling hot neutral solution, the feathers to be dried in a rotating apparatus. Suitable dyes for this method are chrysoidin,

A, C; crystal vesuvin, 4 B C; phosphin extra, leather yellow, O H; leather red, O, G B; leather brown, O; morocco red, O; azophosphine, G O, B R O; fuchsine, cerise, G R; grenadine, O; safranine, O; methylene violet, malachite green, crystal brilliant green, methylene green, methylene gray, coal black II.

II.—A boiling hot sulphuric solution. Dyes, acid fuchsine, orselline, R B; acid cerise, O; acid maroon, O; opal blue, blue de lyon, R B; cotton blue, No. 2, China blue No. 2, naphthalene green, O; patent blue, V A; fast blue, O R; fast blue black, O; deep black, G; azo yellow, victorine yellow, orange No. 2, fast brown O, ponceau G R R R, fast red O, Bordeaux, G B R.

III.—An acetic solution. Dyes, Bengal pink G B, phloxine G O, rosolan O B O F, rhodamine O 4 G, eosine A G, erythrosine.

By appropriate mixtures of the dyes of any one class, plumes can be dyed every possible color. After dyeing they are rinsed, and dried in a rotating apparatus. The final process is that of curling, which is done by turning them round and round over a gentle heat. For white feathers a little sulphur may be burned in the fire; for black or colored ones a little sugar.

FELT HATS, TO STIFFEN:

Borax	5	ounces
Potassium carbonate	1½	ounces
Shellac	25	ounces
Water		

The borax and potassium carbonate should be dissolved in enough hot water to immerse the hat and when in solution the shellac should be added and the solution boiled until the shellac is dissolved, then remove from the fire. This can be applied to the hat with either a sponge brush or by immersion of the hat while cold, then removing the hat and dipping in a very dilute solution of sulphuric acid or acetic acid. This is done to neutralize the alkali and to fix the shellac. The hat should then be shaped and allowed to dry.

FERMENTATION, PREVENTION OF:

See Anti-Ferments and Wines and Liquors.

FERROUS OXALATE DEVELOPER:

See Photography.

Fertilizers

(See also Phosphate, Artificial.)

Plant Fertilizers.—Plants are as sensitive to excessively minute quantities of nutrient substances, such as salts of potassium, in the soil, as they are to

minute quantities of poisonous substances. Poisons are said to be infinitely more sensitive reagents for the presence of certain metallic salts than the most delicate chemical, the statement having been made that a trace of copper which might be obtained by distilling in a copper retort is fatal to the white and yellow lupin, the castor-oil plant, and spirogyra. Coupin has found salts of silver, mercury, copper, and cadmium especially fatal to plants. With copper sulphate the limit of sensitiveness is placed at 1 in 700,000,000. Devaux asserts that both phanerogams and cryptogams are poisoned by solutions of salts of lead or copper diluted to the extent of 1 in 10,000,000, or less.

As a result of a series of experiments, Schloesing stated that the nitrification of ammonium salts is not for all plants a necessary preliminary to the absorption of nitrogen by the plant. While for some plants, as for example buckwheat, the preferable form of the food material is that of a nitrate, others, for instance, tropeolum, thrive even better when the nitrogen is presented to them in an ammoniacal form.

Artificial Fertilizers for Pot Plants.—

Experiments on vegetation have shown that a plant will thrive when the lacking substances are supplied in a suitable form, e. g., in the following combinations:

I.—Calcium nitrate, potassium nitrate, potassium phosphate, magnesium phosphate, ferric phosphate (sodium chloride).

II.—Calcium nitrate, ammonium nitrate, potassium sulphate, magnesium phosphate, iron chloride (or sulphate) (sodium silicate).

It is well known that in nature nitrates are formed wherever decomposition of organic nitrogenous substances takes place in the air, the ammonia formed by the decomposition being oxidized to nitric acid. These conditions for the formation of nitrates are present in nearly every cornfield, and they are also the cause of the presence of nitrates in water that has its source near stables, etc. In Peruvian guano nitrogen is present partly in the form of potassium nitrate, partly as ammonium phosphate and sulphate. As a nitrate it acts more rapidly than in the form of ammonia, but in the latter case the effect is more lasting. Phosphoric acid occurs in guano combined with ammonia, potash, and chiefly with lime, the last being slower and more lasting in action than the others.

Nearly all artificial fertilizers conform, more or less, to one of the following general formulas:

I.—Artificial Flower Fertilizer.—

	1	2	3
Ammonium nitrate.....	0.40	1.60	40.0 parts
Ammonium phosphate....	0.20	0.80	20.0 parts
Potassium nitrate.....	0.25	1.00	25.0 parts
Ammonium chloride.....	0.05	0.20	5.0 parts
Calcium sulphate.....	0.06	0.24	6.0 parts
Ferrous sulphate.....	0.04	0.16	4.0 parts
	1.00	4.00	100.0 parts

Dissolve 1 part in 1,000 parts water, and water the flowers with it 2 or 3 times weekly. Dissolve 4 parts in 1,000 parts water, and water with this quantity 10 or 12 pots of medium size.

II.—Compost for Indoor Plants.—

	1	2	3
Ammonium sulphate.....	0.30	1.20	30.0 parts
Sodium chloride.....	0.30	1.20	30.0 parts
Potassium nitrate.....	0.15	0.60	15.0 parts
Magnesium sulphate.....	0.15	0.60	15.0 parts
Magnesium phosphate....	0.04	0.20	4.0 parts
Sodium phosphate.....	0.06	0.24	6.0 parts
	1.00	4.00	100.0 parts

One part to be dissolved in 1,000 parts water and the flowers watered up to 3 times daily. Dissolve 4 parts in 1,000 parts water, and water with this solution daily:

III.—Plant Food Solution.—

	1	2
Potassium chloride.....	0.16 or	12.5 parts
Calcium nitrate.....	0.71 or	58.0 parts
Magnesium sulphate.....	0.125 or	12.0 parts
Potassium phosphate.....	0.133 or	15.0 parts
Iron phosphate, recently precipitated.....	0.032 or	2.5 parts
	1.160 or	100.0 parts

This turbid mixture (1 part in 1,000 parts) is used alternately with water for watering a pot of about 1 quart capacity; for smaller or larger pots in proportion. After using the amount indicated, the watering is continued with water alone.

IV.—Fertilizer with Organic Matter, for Pot Flowers.—

Potassium nitrate..	100.0 parts
Ammonium phosphate.....	100.0 parts
Phosphoric acid....	2.5 parts
Simple syrup.....	1,000 parts

Add not more than 10 parts to 1,000 parts water, and water alternately with this and with water alone. For cactaceæ, crassulaceæ, and similar plants, which do not assimilate organic matter directly, use distilled water instead of syrup.

Chlorotic plants are painted with a

dilute iron solution or iron is added to the soil, which causes them to assume their natural green color. The iron is used in form of ferric chloride or ferrous sulphate.

V.—Sodium phosphate	4 ounces
Sodium nitrate....	4 ounces
Ammonium sulphate.....	2 ounces
Sugar.....	1 ounce

Use 2 teaspoonfuls to a gallon of water.

VI.—Ammonium phosphate	30 parts
Sodium nitrate.....	25 parts
Potassium nitrate.....	25 parts
Ammonium sulphate..	20 parts
Water.....	100,000 parts

One application of this a week is enough for the slower growing plants, and 2 for the more rapid growing herbaceous ones.

VII.—Calcium phosphate.....	4 ounces
Potassium nitrate	1 ounce
Potassium phosphate.....	1 ounce
Magnesium sulphate.....	1 ounce
Iron (ferric) phosphate.....	100 grains

VIII.—Pot plants, especially flowering plants kept around the house, should be treated to an occasional dose of the following:

Ammonium chloride.....	2 parts
Sodium phosphate	4 parts
Sodium nitrate....	3 parts
Water.....	80 parts

Mix and dissolve. To use, add 25 drops to the quart of water, and use as in ordinary watering.

IX.—Sugar.....	1 part
Potassium nitrate..	2 parts
Ammonium sulphate.....	4 parts

X.—Ferric phosphate..	1 part
Magnesium sulphate.....	2 parts
Potassium phosphate.....	2 parts
Potassium nitrate..	2 parts
Calcium acid phosphate.....	8 parts

About a teaspoonful of either of these mixtures is added to a gallon of water, and the plants sprinkled with the liquid. For hastening the growth of flowers, the following fertilizer is recommended:

XI.—Potassium nitrate.	30 parts
Potassium phosphate.....	25 parts
Ammonium sulphate.....	10 parts
Ammonium nitrate	35 parts

The following five are especially recommended for indoor use:

XII.—Sodium chloride..	10 parts
Potassium nitrate.	5 parts
Magnesium sulphate.....	5 parts
Magnesia.....	1 part
Sodium phosphate	2 parts

Mixed and bottled. Dissolve a teaspoonful daily in a quart of water and water the plants with the solution.

XIII.—Ammonium nitrate	40 parts
Potassium nitrate.	90 parts
Ammonium phosphate.....	50 parts

Two grams is sufficient for a medium-sized flower pot.

XIV.—Ammonium sulphate.....	10 parts
Sodium chloride..	10 parts
Potassium nitrate.	5 parts
Magnesium sulphate.....	5 parts
Magnesium carbonate.....	1 part
Sodium phosphate	20 parts

One teaspoonful to 1 quart of water.

XV.—Ammonium nitrate	40 parts
Ammonium phosphate.....	20 parts
Potassium nitrate.	0.25 parts
Ammonium chloride.....	5 parts
Calcium sulphate.	6 parts
Ferrous sulphate..	4 parts

Dissolve 2 parts in 1,000 of water, and water the plants with the solution.

XVI.—Potassium nitrate.	20 parts
Potassium phosphate.....	25 parts
Ammonium sulphate.....	10 parts
Ammonium nitrate	35 parts

This mixture produces a luxuriant foliage. If blooms are desired, dispense with the ammonium nitrate.

XVII.—Saltpeter, 5 parts; cooking salt, 10 parts; bitter salt, 5 parts; magnesia, 1 part; sodium phosphate, 2 parts. Mix and fill in bottles. Dissolve a teaspoonful in $1\frac{1}{2}$ pints of hot water, and water the flower pots with it each day.

XVIII.—Ammonium sulphate, 30 parts; sodium chloride, 30 parts; potash niter, 15 parts; magnesium sulphate, 15 parts; magnesium phosphate, 4 parts; sodium phosphate, 6 parts. Dissolve 1 part in 1,000 parts water, and apply 3 times per day.

XIX.—Calcium nitrate, 71 parts; potassium chlorate, 15 parts; magnesium sulphate, 12.5 parts; potassium phosphate, 13.3 parts; freshly precipitated ferric phosphate, 3.2 parts. A solution of 1 in 1,000 of this mixture is applied, alternating with water, to the plants. After using a certain quantity, pour on only water.

XX.—Ammonium phosphate, 300 parts; sodium nitrate, 250 parts; potassium nitrate, 250 parts; and ammonium sulphate, 200 parts, are mixed together. To every 1,000 parts of water dissolve 2 parts of the mixture, and water the potted plants once a week with this solution.

XXI.—Potash niter, 20 parts; calcium carbonate, 20 parts; sodium chlorate, 20 parts; calcium phosphate, 20 parts; sodium silicate, 14 parts; ferrous sulphate, 1.5 parts. Dissolve 1 part of the mixture in 1,000 parts water.

Preparing Bone for Fertilizer.—Bone, in its various forms, is the only one of the insoluble phosphates that is now used directly upon the soil, or without other change than is accomplished by mechanical action or grinding. The terms used to indicate the character of the bone have reference rather to their mechanical form than to the relative availability of the phosphoric acid contained in them. The terms raw bone, fine bone, boiled and steamed bone, etc., are used to indicate methods of preparation, and inasmuch as bone is a material which is useful largely in proportion to its rate of decay, its fineness has an important bearing upon availability, since the finer the bone the more surface is exposed to the action of those forces which cause decay or solution, and the quicker will the constituents become available. In the process of boiling or steaming, not only is the bone made finer but its physical character in other respects is also changed, the particles, whether fine or coarse, being made soft and crumbly rather than dense or hard; hence it is more likely to act quickly than if the same degree of fineness be obtained by simple grinding. The phosphoric acid in fine steamed bone may all become available in 1 or 2 years, while the coarser fatty raw bone sometimes resists final decay for 3 or 4 years or even longer.

Bone contains considerable nitrogen, a fact which should be remembered in its use, particularly if used in comparison with other phosphatic materials which do not contain this element. Pure raw bone contains on an average 22 per cent of phosphoric acid and 4 per cent of nitrogen. By steaming or boiling, a portion of the organic substance containing nitrogen is extracted, which has the effect of proportionately increasing the phosphoric acid in the product; hence a steamed bone may contain as high as 28 per cent of phosphoric acid and as low as 1 per cent of nitrogen. Steamed bone is usually, therefore, much richer in phosphoric acid and has less nitrogen than the raw bone.

Brewers' Yeast and Fertilizers.—A mixture is made of about 2 parts of yeast with 1 part of sodium chloride and 5 parts of calcium sulphate, by weight, for use as a manure. Pure or impure yeast, or yeast previously treated for the extraction of a portion of its constituents, may be used, and the gypsum may be replaced by other earthy substances of a similar non-corrosive nature.

Authorities seem to agree that lime is necessary to the plant, and if it be wholly lacking in the soil, even though an abundance of all the other essential elements is present, it cannot develop normally. Many soils are well provided with lime by nature and it is seldom or never necessary for those who cultivate them to resort to liming. It would be just as irrational to apply lime where it is not needed as to omit it where it is required, and hence arises the necessity of ascertaining the needs of particular soils in this respect.

The method usually resorted to for ascertaining the amount of lime in soils is to treat them with some strong mineral acid, such as hydrochloric acid, and determine the amount of lime which is thus dissolved. The fact that beets of all kinds make a ready response to liming on soils which are deficient in lime may be utilized as the basis of testing.

FEVER IN CATTLE:

See Veterinary Formulas.

FIG SQUARES:

See Confectionery.

Files

Composition Files.—These files, which are frequently used by watchmakers and other metal workers for grinding and polishing, and the color of which resembles

silver, are composed of 8 parts copper, 2 parts tin, 1 part zinc, 1 part lead. They are cast in forms and treated upon the grindstone; the metal is very hard, and therefore worked with difficulty with the file.

To Keep Files Clean (see also *Cleaning Preparations and Methods*).—The uneven working of a file is usually due to the fact that filings clog the teeth of the file. To obviate this evil, scratch brush the files before use, and then grease them with olive oil. A file prepared in this manner lasts for a longer time, does not become so quickly filled with filings and can be conveniently cleaned with an ordinary rough brush.

Recutting Old Files.—Old files may be rendered useful again by the following process: Boil them in a potash bath, brush them with a hard brush and wipe off. Plunge for half a minute into nitric acid, and pass over a cloth stretched tightly on a flat piece of wood. The effect will be that the acid remains in the grooves, and will take away the steel without attacking the top, which has been wiped dry. The operation may be repeated according to the depth to be obtained. Before using the files thus treated they should be rinsed in water and dried.

FILE METAL:

See Alloys.

FILLERS FOR LETTERS:

See Lettering.

FILLERS FOR WOOD:

See Wood.

FILTERS FOR WATER.

A filter which possesses the advantages of being easily and cheaply cleaned when dirty, and which frees water from mechanical impurities with rapidity, may be formed by placing a stratum of sponge between two perforated metallic plates, united by a central screw, and arranged in such a manner as to permit of the sponge being compressed as required. Water, under gentle pressure, flows with such rapidity through the pores of compressed sponge, that it is said that a few square feet of this substance will perfectly filter several millions of gallons of water daily.

The sponges are cleaned thoroughly, rolled together as much as possible, and placed in the escape pipe of a percolator in such a manner that the larger portion of the sponge is in the pipe while the smaller portion, spreading by itself, protrudes over the pipe toward the interior

of the percolator, thus forming a flat filter covering it. After a thorough moistening of the sponge it is said to admit of a very quick and clear filtration of large quantities of tinctures, juices, etc.

For filtering water on a small scale, and for domestic use, "alcarrazas," diaphragms of porous earthenware and filtering-stone and layers of sand and charcoal, etc., are commonly employed as filtering.

A cheap, useful form of portable filter is the following, given in the proceedings of the British Association: "Take any common vessel, perforated below, such as a flower pot, fill the lower portion with coarse pebbles, over which place a layer of finer ones, and on these a layer of clean coarse sand. On the top of this a piece of burnt clay perforated with small holes should be put, and on this again a stratum of 3 or 4 inches thick of well-burnt, pounded animal charcoal. A filter thus formed will last a considerable time, and will be found particularly useful in removing noxious and putrescent substances held in solution by water."

The "portable filters," in stoneware, that are commonly sold in the shops, contain a stratum of sand, or coarsely powdered charcoal; before, however, having access to this, the water has to pass through a sponge, to remove the coarser portion of the impurities.

Alum Process of Water Purification.—Water may be filtered and purified by precipitation, by means of alum, by adding a 4 per cent solution to the water to be clarified until a precipitate is no longer produced. After allowing the turbid mixture to stand for 8 hours, the clear portion may be decanted or be siphoned off. About 2 grains of alum is ordinarily required to purify a gallon of water. Potassa alum only should be used, as ammonia alum cannot be used for this purpose. The amount of alum required varies with the water, so that an initial experiment is required whenever water from a new source is being purified. If the purification is properly done, the water will not contain any alum, but only a trace of potassium sulphate, for the aluminium of the double sulphate unites with the various impurities to form an insoluble compound which gradually settles out, mechanically carrying with it suspended matter, while the sulphuric acid radical unites with the calcium in the water to form insoluble calcium sulphate.

FILTER PAPER:

See Paper.

FIRE EXTINGUISHER (For Automobiles):

Mix well together:

98 Parts of Carbonate of Soda
2 Parts of Oxide of Iron

When this mixture is thrown on a fire carbonic gas is liberated. This gas being heavier than air, smothers the fire.

FIREARM LUBRICANTS:

See Lubricants.

FIRE EXTINGUISHERS:

I.—Calcium chloride. 184 parts
Magnesium chloride..... 57 parts
Sodium chloride.. 13 parts
Potassium bromide..... 22 parts
Barium chloride.. 3 parts
Water to make... 1,000 parts
Dissolve and fill into hand grenades.

II.—Iron sulphate..... 4 parts
Ammonium sulphate..... 16 parts
Water..... 100 parts
Mix, dissolve, and fill into flasks.

III.—Sodium chloride... 430 parts
Alum..... 195 parts
Glauber salts..... 50 parts
Sodium carbonate, impure..... 35 parts
Water glass..... 266 parts
Water..... 233 parts
Mix, etc.

IV.—Sodium chloride... 90 parts
Ammonium chloride..... 45 parts
Water..... 300 parts

Mix, dissolve, and put into quart flasks of very thin glass, which are to be kept conveniently disposed in the dwelling rooms, etc., of all public institutions.

V.—Make 6 solutions as follows:

a.—Ammonium chloride..... 20 parts
Water..... 2,000 parts

b.—Alum, calcined and powdered 35 parts
Water..... 1,000 parts

c.—Ammonium sulphate, powdered..... 30 parts
Water..... 500 parts

d.—Sodium chloride 20 parts
Water..... 4,000 parts

e.—Sodium carbonate..... 35 parts
Water..... 500 parts

f.—Liquid water glass..... 450 parts

Mix the solutions in the order named and to the mixture, while still yellow and turbid, add 2,000 parts of water, and let stand. When the precipitate has subsided fill off the clear liquid into thin glass (preferably blue, to deter decomposition) containers each of 3 pints to a half gallon capacity.

VI.—Calcium chloride..	30 parts
Magnesium chloride.....	10 parts
Water.....	60 parts
VII.—Sodium chloride..	20 parts
Ammonium chloride.....	9 parts
Water.....	71 parts
VIII.—Sodium carbonate	16 parts
Sodium chloride.	64 parts
Water.....	920 parts

The most effective of all extinguishers is ammonia water. It is almost instantaneous in its effect, and a small quantity only is required to extinguish any fire. Next in value is carbonic acid gas. This may be thrown from siphons or soda-water tanks. The vessel containing it should be thrown into the fire in such a way as to insure its breaking.

Dry Powder Fire Extinguishers.—The efficacy of these is doubted by good authorities. They should be tested before adoption.

I.—Alum.....	24 parts
Ammonium sulphate	52 parts
Ferrous sulphate....	4 parts
II.—Sodium chloride....	8 parts
Sodium bicarbonate	6 parts
Sodium sulphate....	2 parts
Calcium chloride....	2 parts
Sodium silicate.....	2 parts
III.—Sodium chloride....	6 parts
Ammonium chloride	6 parts
Sodium bicarbonate..	8 parts
IV.—Ammonium chloride	10 parts
Sodium sulphate....	6 parts
Sodium bicarbonate	4 parts

Oil Extinguisher.—To extinguish oils which have taken fire, a fine-meshed wire net of the size of a boiling pan should be kept on hand in every varnish factory, etc. In the same moment when the netting is laid upon the burning surface, the flame is extinguished because it is a glowing mass of gas, which the iron wire quickly cools off so that it cannot glow any more. The use of water is excluded, and that of earth and sand undesirable, because both dirty the oil.

Substitute for Fire Grenades.—A common quart bottle filled with a saturated solution of common salt makes a cheap and efficient substitute for the ordinary hand grenade. The salt forms a coating on all that the water touches and makes it nearly incombustible.

Fireproofing

For Textiles.—I.—Up to the present this has generally been accomplished by the use of a combination of water glass or soluble glass and tungstate of soda. The following is cheaper and more suitable for the purpose:

Equal parts, by weight, of commercial white copperas, Epsom salt, and sal ammoniac are mingled together and mixed with three times their weight of ammonia alum. This mixture soon changes into a moist pulp or paste, that must be dried by a low heat. When dressing the material, add $\frac{1}{2}$ part of this combination to every 1 part of starch.

II.—Good results are also obtained from the following formula: Supersaturate a quantity of superphosphate of lime with ammonia, filter, and decolorize it with animal charcoal. Concentrate the solution and mix with it 5 per cent of gelatinous silica, evaporate the water, dry, and pulverize. For use mix 30 parts of this powder with 35 parts of gum and 35 parts of starch in sufficient water to make of suitable consistency.

III.—As a sample of the Melunay process, introduced in France, the following has been published: Apply to a cotton fabric like flannellet, or other cotton goods, a solution of stannate of soda (or a salt chemically equivalent) of the strength of 5 to 10° Bé., then dry the fabric and saturate it again, this time with a solution of a titanium salt; any soluble titanium salt is suitable. This salt should be so concentrated that each 1,000 parts may contain about 62 parts of titanium oxide. The fabrics are again dried, and the titanium is ultimately fixed by means of a suitable alkaline bath. It is advantageous to employ for this purpose a solution of silicate of soda of about 14° Bé., but a mixed bath, composed of tungstate of soda and ammonium chloride, may be employed. The objects are afterwards washed, dried, and finished as necessary for trade. A variation consists in treating the objects in a mixed bath containing titanium, tungsten, and a suitable solvent.

IV.—Boil together, with constant

stirring, the following ingredients until a homogeneous mass results:

Linseed oil.....	77	parts
Litharge.....	10	parts
Sugar of lead.....	2	parts
Lampblack.....	4	parts
Oil turpentine.....	2	parts
Umber.....	0.4	parts
Japanese wax.....	0.3	parts
Soap powder.....	1.2	parts
Manila copal.....	0.7	parts
Caoutchouc varnish..	2	parts

V.—For Light Woven Fabrics.—

Ammonium sulphate, 8 parts, by weight; ammonium carbonate, 2.5 parts; borax, 2; boracic acid, 3; starch, 2; or dextrin, 0.4, or gelatin, 0.4; water, 100. The fabric is to be saturated with the mixture, previously heated to 86° F., and dried; it can then be calendered in the ordinary way. The cost is only 2 or 3 cents for 16 yards or more of material.

VI.—For Rope and Straw Matting.—

Ammonium chloride (sal ammoniac), 15 parts, by weight; boracic acid, 6 parts; borax, 3; water, 100. The articles are to be left in the solution, heated to 212° F. for about 3 hours, then squeezed out and dried. The mixture costs about 5 cents a quart.

VII.—For Clothing.—The following starch is recommended: Sodium tungstate, perfectly neutral, 30 parts; borax, 20; wheat or rice starch, 60. The constituents are to be finely pulverized, sharply dried, and mixed, and the starch used like any other. Articles stiffened with it, if set on fire, will not burst into flame, but only smolder.

VIII.—For Tents.—

Water.....	100	} Parts by weight.
Ammonium sulphate, chemically pure.....	14	
Boracic acid..	1	
Hartshorn salt	1	
Borax.....	3	
Glue water....	2	

Boil the water, put ammonium sulphate into a vat, pour a part of the boiling water on and then add the remaining materials in rotation. Next follow the rest of the hot water. The vat should be kept covered until the solution is complete.

IX.—For Stage Decorations.—Much recommended and used as a fireproofing composition is a cheap mixture of

borax, bitter salt, and water; likewise for canvas a mixture of ammonium sulphate, gypsum, and water. Ammonium sulphate and sodium tungstate are also named for impregnating the canvas before painting.

X.—For Mosquito Netting.—Immerse in a 20 per cent solution of ammonium sulphate. One pound of netting will require from 20 to 24 ounces of the solution to thoroughly saturate. After withdrawing from the bath, do not wring it out, but spread it over a pole or some such object, and let it get about half dry, then iron it out with a hot iron. The material (ammonium sulphate) is inoffensive.

Fireproofing of Wood.—Strictly speaking, it is impossible to render wood completely incombustible, but an almost absolute immunity against the attacks of fire can be imparted.

Gay-Lussac was one of the first to lay down the principal conditions indispensable for rendering organic matters in general, and wood in particular, unflammable.

During the whole duration of the action of the heat the fibers must be kept from contact with the air, which would cause combustion. The presence of borates, silicates, etc., imparts this property to organic bodies.

Combustible gases, disengaged by the action of the heat, must be mingled in sufficient proportion with other gases difficult of combustion in such a way that the disorganization of bodies by heat will be reduced to a simple calcination without production of flame. Salts volatile or decomposable by heat and not combustible, like certain ammoniacal salts, afford excellent results.

Numerous processes have been recommended for combating the inflammability of organic tissues, some consisting in external applications, others in injection, under a certain pressure, of saline solutions.

By simple superficial applications only illusory protection is attained, for these coverings, instead of fireproofing the objects on which they are applied, preserve them only for the moment from a slight flame. Resistance to the fire being of only short duration, these coatings scale off or are rapidly reduced to ashes and the parts covered are again exposed. It often happens, too, that such coatings have disappeared before the occurrence of a fire, so that the so-called remedy becomes injurious from the false security occasioned.

Some formulas recommended are as follows:

I.—For immersion or imbibition the following solution is advised: Ammonium phosphate, 100 parts; boracic acid, 10 parts per 1,000; or ammonium sulphate, 135 parts; sodium borate, 15 parts; boracic acid, 5 parts per 1,000. For each of these formulas two coats are necessary.

II.—For application with the brush the following compositions are the best:

a. Apply hot, sodium silicate, 100 parts; Spanish white, 50 parts; glue, 100 parts.

b. Apply successively and hot; for first application, water, 100 parts; aluminum sulphate, 20 parts; second application, water, 100 parts; liquid sodium silicate, 50 parts.

c. First application, 2 coats, hot; water, 100 parts; sodium silicate, 50 parts; second application, 2 coatings; boiling water, 75 parts; gelatin, white, 200 parts; work up with asbestos, 50 parts; borax, 30 parts; and boracic acid, 10 parts.

Oil paints rendered unflammable by the addition of phosphate of ammonia and borax in the form of impalpable powders incorporated in the mass, mortar of plaster and asbestos and asbestos paint, are still employed for preserving temporarily from limited exposure to a fire.

III.—Sodium silicate,
solid..... 350 parts
Asbestos, powdered..... 350 parts
Water, boiling.... 1,000 parts

Mix. Give several coatings, letting each dry before applying the next.

IV.—Asbestos, powdered 35 parts
Sodium borate.... 20 parts
Water..... 100 parts
Gum lac..... 10 to 15 parts

Dissolve the borax in the water by the aid of heat, and in the hot solution dissolve the lac. When solution is complete incorporate the asbestos. These last solutions give a superficial protection, the efficiency of which depends upon the number of coatings given.

V.—Prepare a syrupy solution of sodium silicate, 1 part, and water, 3 parts, and coat the wood 2 to 3 times, thus imparting to it great hardness. After drying, it is given a coating of lime of the consistency of milk, and when this is almost dry, is fixed by a strong solution of

soluble glass, 2 parts of the syrupy mass to 3 parts of water. If the lime is applied thick, repeat the treatment with the soluble glass.

VI.—Subject the wood or wooden objects for 6 to 8 hours to the boiling heat of a solution of 33 parts of manganese chloride, 20 parts of orthophosphoric acid, 12 parts of magnesium carbonate, 10 parts of boracic acid, and 25 parts of ammonium chloride in 1,000 parts of water. The wood thus treated is said to be perfectly incombustible even at great heat, and, besides, to be also protected by this method against decay, injury by insects, and putrefaction.

VII.—One of the simplest methods is to saturate the timber with a solution of tungstate of soda; if this is done in a vacuum chamber, by means of which the wood is partly deprived of the air contained in its cells, a very satisfactory result will be obtained. Payne's process consists in treating wood under these conditions first with solution of sulphate of iron, and then with chloride of calcium; calcium sulphate is thus precipitated in the tissues of the timber, which is rendered incombustible and much more durable. There are several other methods besides these, phosphate of ammonia and tungstate being most useful. A coat of common whitewash is an excellent means of lessening the combustibility of soft wood.

Fireproofing Wood Pulp.—The pulp is introduced into a boiler containing a hot solution of sulphate and phosphate of ammonia and provided with a stirring and mixing apparatus, as well as with an arrangement for regulating the temperature. After treatment, the pulp is taken out and compressed in order to free it from its humidity. When dry, it may be used for the manufacture of paper or for analogous purposes. Sawdust treated in the same manner may be used for packing goods, for deadening walls, and as a jacketing for steam pipes.

Fireproofing for Wood, Straw, Textiles, etc.—The material to be made fireproof is treated with a solution of 10 to 20 parts of potassium carbonate and 4 to 8 parts of ammonium borate in 100 parts of water. Wherever excessive heat occurs, this compound, which covers the substance, is formed into a glassy mass, thus protecting the stuff from burning; at the same time a considerable amount of carbonic acid is given off, which smothers the flames.

MISCELLANEOUS FORMULAS FOR FIREPROOFING.

I.—In coating steel or other furnaces, first brush over the brickwork to be covered a solution made by boiling 1 pound each of silicate of soda and alum in 4 gallons of water, and follow immediately with composition:

Silica.....	50 parts
Plastic fire clay	10 parts
Ball clay.....	3 parts

Mix well.

Fireproof Compositions.—II.—For furnaces, etc.:

Pure silica (in grain)	60 parts
Ground flint.....	8 parts
Plaster of Paris.....	3 parts
Ball clay.....	3 parts

Mix well together by passing once or more through a fine sieve, and use in the same way as cement.

Fireproof Paper.—Paper is rendered fireproof by saturating it with a solution of

Ammonium sulphate.	8 parts
Boracic acid.....	3 parts
Borax.....	2 parts
Water.....	100 parts

For the same purpose sodium tungstate may also be employed.

Fireproof Coating.—A fireproof coating (so-called) consists of water, 100 parts; strong glue, 20 parts; silicate of soda, 38° Bé., 50 parts; carbonate of soda, 35 parts; cork in pieces of the size of a pea, 100 parts.

Colored Fireproofing. — I. — Ammonium sulphate, 70 parts; borax, 50 parts; glue, 1 part; and water up to 1,000 parts.

II.—Solution of glue, 5 parts, zinc chloride, 2 parts; sal ammoniac, 80 parts; borax, 57 parts; and water up to 700 parts.

If the coating is to be made visible by coloration, an addition of 10 parts of Cassel brown and 6 parts of soda per 1,000 parts is recommended, which may be dissolved separately in a portion of the water used.

FIREPROOFING MATCHES:

Mix a small quantity, $\frac{1}{2}$ ounce or so of water glass thoroughly. Hold the match by the head and dip it in the water glass to a depth of $\frac{1}{2}$ or $\frac{3}{4}$ inch from the end. Let it then dry. This makes the handle of the match fireproof, and it will go out when it comes to the treated wood.

FISH BAIT.

Oil of rhodium.....	3 parts
Oil of cumin.....	2 parts
Tincture of musk.....	1 part

Mix. Put a drop or two on the bait, or rub trigger of trap with the solution.

FIXATIVES FOR CRAYON DRAWINGS, ETC.

I.—Shellac.....	40	} Parts by weight.
Sandarac.....	20	
Spirit of wine.	940	

II.—During the Civil War, when both alcohol and shellac often were not purchasable, and where, in the field especially, ink was almost unknown, and sized paper, of any description, a rarity, men in the field were compelled to use the pencil for correspondence of all sorts. Where the communication was of a nature to make its permanency desirable, the paper was simply dipped in skim milk, which effected the purpose admirably. Such documents written with a pencil on unsized paper have stood the wear and rubbing of upward of 40 years.

To Fix Pounced Designs.—Take beer or milk or alcohol, in which a little bleached shellac has been dissolved, and blow one of these liquids upon the freshly pounced design by means of an atomizer. After drying, the drawing will have the desired fixedness.

FIXING BATHS FOR PAPER AND NEGATIVES:

See Photography.

FLANNELS, WHITENING OF:

See Laundry Preparations.

FLASH-LIGHT APPARATUS AND POWDERS:

See Photography.

FLAVORINGS:

See Condiments.

FLEA DESTROYERS:

See Insecticides.

FLIES IN THE HOUSE:

See Household Formulas.

FLIES AND PAINT:

See Paint.

Floor Dressings

(See also Paint, Polishes, Waxes, and Wood.)

Oil Stains for Hard Floors.—I.—Burnt sienna, slate brown, or wine black, is ground with strong oil varnish in the paint mill. The glazing color obtained

is thinned with a mixture of oil of turpentine and applied with a brush on the respective object. The superfluous stain is at once wiped away with a rag, so that only the absorbed stain remains in the wood. If this is uneven, go over the light places again with dark stain. In a similar manner all otherwise tinted and colored oil stains are produced by merely grinding the respective color with the corresponding addition of oil. Thus, green, red, and even blue and violet shades on wood can be obtained, it being necessary only to make a previous experiment with the stains on a piece of suitable wood. In the case of soft wood, however, it is advisable to stain the whole previously with ordinary nut stain (not too dark), and only after drying to coat with oil stain, because the autumn rings of the wood take no color, and would appear too light, and, therefore, disturb the effect.

FLOORING, SANI-TEX COMPOSITION:

BLACK, GRAY OR GREEN:

Magnesite	11 pounds
Asbestos fiber	3 pounds
Silica	3 pounds
Wood flour	1 pound
Talc	1 pound
Color	1 pound

If a BROWN color flooring is wanted, use:

Magnesite	11 pounds
Asbestos fiber	2 pounds
Silica	3 pounds
Wood flour	1 pound
Talc	1 pound
Color	2 pounds

For a RED and WHITE flooring, use:

Magnesite	11 pounds
Asbestos fiber	3 pounds
Silica	2 pounds
Wood flour	1 pound
Talc	1 pound
Color	2 pounds

For a YELLOW flooring, use:

Magnesite	11 pounds
Asbestos fiber	$\frac{3}{5}$ pound
Silica	3 pounds
Wood flour	1 pound
Talc	2 pounds
Color	$2\frac{1}{2}$ pounds

These make a small quantity. For 100 lbs., multiply figures by five.

Paraffining of Floors.—The cracks and joints of the parquet floor are filled with a putty consisting of Spanish white, 540 parts; glue, 180 parts; sienna, 150 parts;

umber, 110 parts; and calcareous earth, 20 parts. After 48 hours apply the paraffine, which is previously dissolved in petroleum, or preferably employed in a boiling condition, in which case it will enter slightly into the floor. When solidification sets in, the superfluous paraffine is scratched off and an even, smooth surface of glossy color results, which withstands acids and alkalis.

Ball-Room Floor Powder.—

Hard paraffine.....	1 pound
Powdered boric acid..	7 pounds
Oil lavender.....	1 drachm
Oil neroli.....	20 minims

Melt the paraffine and add the boric acid and the perfumes. Mix well, and sift through a $\frac{1}{16}$ mesh sieve.

Renovating Old Parquet Floors.—

A good formula for renovating old parquet floors is prepared as follows:

Benzol	4 pints
Amyl acetate	3 pints
Carbon tetrachloride ...	1 pint

Apply this mixture to the wooden floor and allow to stand for a few minutes or until the old coating has been softened. Then scrape the floor clean with a putty knife or with steel wool. Clean thoroughly and when dry, wax or varnish as desired.

When using the above mixture caution should be exercised not to have any open flames in the vicinity and also to have good ventilation as the vapors given off are toxic and inflammable.

FLOOR OIL:

See Oils.

FLOOR PAPER:

See Paper.

FLOOR POLISH:

See Polishes.

FLOOR VARNISHES:

See Varnishes.

FLOOR WATERPROOFING:

See Waterproofing.

FLOOR WAX:

See Waxes.

FLORICIN OIL:

See Oil.

FLOWER PRESERVATIVES.

1.—To preserve flowers they should be dipped in melted paraffine, which should be just hot enough to maintain its fluidity. The flowers should be dipped one at a time, held by the stalks and moved about for an instant to get rid of air bubbles. Fresh cut flowers, free from moisture,

are said to make excellent specimens when treated in this way. A solution in which cut flowers may be kept immersed is made as follows:

Salicylic acid.....	20 grains
Formaldehyde.....	10 minims
Alcohol.....	2 fluidounces
Distilled water.....	1 quart

II.—The English method of preserving flowers so as to retain their form and color is to imbed the plants in a mixture of equal quantities of plaster of Paris and lime, and gradually heat them to a temperature of 100° F. After this the flower looks dusty, but if it is laid aside for an hour so as to absorb sufficient moisture to destroy its brittleness, it can be dusted without injury. To remove the hoary appearance which is often left, even after dusting, a varnish composed of 5 ounces of dammar and 16 ounces of oil of turpentine should be used and a second coat given if necessary. When the gum has been dissolved in the turpentine, 16 ounces of benzoline should be added, and the whole should be strained through fine muslin.

III.—Five hundred parts ether, 20 parts transparent copal, and 20 parts sand. The flowers should be immersed in the varnish for 2 minutes, then allowed to dry for 10 minutes, and this treatment should be repeated 5 or 6 times.

IV.—Place the flowers in a solution of 30 grains of salicylic acid in 1 quart of water.

V.—Moisten 1,000 parts of fine white sand that has been previously well washed and thoroughly dried and sifted, with a solution consisting of 3 parts of stearine, 3 parts of paraffine, 3 parts of salicylic acid, and 100 parts of alcohol. Work the sand up thoroughly so that every grain of it is impregnated with the mixture, and then spread it out and let it become perfectly dry. To use, place the flowers in a suitable box, the bottom of which has been covered with a portion of the prepared sand, and then dust the latter over them until all the interstices have been completely filled with it. Close the box lightly and put it in a place where it can be maintained at a temperature of from 86° to 104° F. for 2 or 3 days. At the expiration of this time remove the box and let the sand escape. The flowers can then be put into suitable receptacles or glass cases without fear of deterioration. Wilted or withered flowers should be freshened up by dipping into a suitable aniline solution, which will restore their color.

VI.—Stand the flowers upright in a box of proper size and pour over and around them fine dry sand, until the flowers are completely surrounded in every direction. Leave them in this way for 8 or 10 days, then carefully pour off the sand. The flowers retain their color and shape perfectly, but in very fleshy, juicy specimens the sand must be renewed. To be effective the sand must be as nearly dry as possible.

VII.—A method of preserving cut flowers in a condition of freshness is to dissolve small amounts of ammonium chloride, potassium nitrate, sodium carbonate or camphor in the water into which the stems are inserted. The presence of one or more of these drugs keeps the flowers from losing their turgidity by stimulating the cells to action and by opposing germ growth. Flowers that have already wilted are said to revive quickly if the stems are inserted in a weak camphor water.

Stuccoed Gypsum Flowers.—Take natural flowers, and coat the lower sides of their petals and stamens with paraffine or with a mixture of glue, gypsum, and lime, which is applied lightly. Very fine parts of the flowers, such as stamens, etc., may be previously supported by special attachments of textures, wire, etc. After the drying of the coating the whole is covered with shellac solution or with a mixture of glue, gypsum, lime with lead acetate, oil, mucilage, glycerine, colophony, etc. If desired, the surface may be painted with bronzes in various shades. Such flowers are much employed in the shape of festoons for decorating walls, etc.

Artificial Coloring of Flowers.—A method employed by florists to impart a green color to the white petals of "carnation pinks" consists in allowing long-stemmed flowers to stand in water containing a green aniline dye. When the flowers are fresh they absorb the fluid readily, and the dye is carried to the petals.

Where the original color of the flower is white, colored stripes can be produced upon the petals by putting the cut ends into water impregnated with a suitable aniline dye. Some dyes can thus be taken up by the capillary action of the stem and deposited in the tissue of the petal. If flowers are placed over a basin of water containing a very small amount of ammonia in a bell glass, the colors of the petals will generally show some marked change. Many violet-colored flowers when so treated will become

green, and if the petals contain several tints they will show greens where reds were, yellows where they were white, and deep carmine will become black. When such flowers are put into water they will retain their changed colors for hours.

If violet asters are moistened with very dilute nitric acid, the ray florets become red and acquire an agreeable odor.

FLUID MEASURES:

See Weights and Measures.

FLUORESCENT LIQUIDS.

Æsculin gives pale blue by (1) reflected light, straw color by (2) transmitted light. Amido-phthalic acid, pale violet (1), pale yellow (2). Amido-terephthalic acid, bright green (1), pale green (2).

Eosine, yellow green (1), orange (2).

Fluorescein, intense green (1), orange yellow (2).

Fraxin, blue green (1), pale green (2).

Magdala red, opaque scarlet (1), brilliant carmine (2).

Quinine, pale blue (1), no color (2).

Safranine, yellow red (1), crimson (2).

FLUXES USED IN ENAMELING:

See Enameling.

FLUXES FOR SOLDERING:

See Soldering.

Fly-Papers and Fly-Poisons

(See also Insecticides.)

Sticky Fly-Papers.—The sticky material applied to the paper is the following:

- I.—Boiled linseed oil. 5 to 7 parts
- Gum thus. 2 to 3 parts
- Non-drying oil. . . 3 to 7 parts

For the non-drying oil, cottonseed, castor, or neatsfoot will answer—in fact, any of the cheaper oils that do not readily dry or harden will answer. The proper amount of each ingredient depends upon the condition of the boiled oil. If it is boiled down very stiff, more of the other ingredients will be necessary, while if thin, less will be required.

- II.—Rosin. 8 parts
- Rapeseed oil. 4 parts
- Honey. 1 part

Melt the rosin and oil together, and incorporate the honey. Two parts of raw linseed oil and 2 parts of honey may be used along with 8 parts of rosin instead of the foregoing. Use paper already sized, as it comes from the mills, on which to spread the mixture.

- III.—Castor oil. 12 ounces
- Rosin. 27 ounces

Melt together and spread on paper sized with glue, using 12 ounces glue to 4 pints water.

- IV.—Rosin. 8 ounces
- Venice turpentine. . . 2 ounces
- Castor oil. 2 ounces

Spread on paper sized with glue.

Poisonous Fly-Papers.—

- I.—Quassia chips. . . . 150 parts
- Chloride of cobalt. . . 10 parts
- Tartar emetic. 2 parts
- Tincture of long pepper (1 to 4) . . . 80 parts
- Water. 400 parts

Boil the quassia in the water until the liquid is reduced one-half, strain, add the other ingredients, saturate common absorbent paper with the solution, and dry. The paper is used in the ordinary way.

- II.—Potassium bichromate 10 ounces
- Sugar 3 drachms
- Oil of black pepper. . . 2 drachms
- Alcohol 2 ounces
- Water. 14 ounces

Mix and let stand for several days, then soak unsized paper with the solution.

- III.—Cobalt chloride. . . . 4 drachms
- Hot water. 16 ounces
- Brown sugar. 1 ounce

Dissolve the cobalt in the water and add the sugar, saturate unsized paper in the solution, and hang up to dry.

- IV.—Quassia chips. . . . 150 parts
- Cobalt chloride. . . . 10 parts
- Tartrate antimony. . . 2 parts
- Tincture of pepper. . . 80 parts
- Water 400 parts

Boil chips in the water until the volume of the latter is reduced one-half, add other ingredients and saturate paper and dry.

Fly-Poison.—

- Pepper. 4 ounces
- Quassia. 4 ounces
- Sugar. 8 ounces
- Diluted alcohol. . . . 4 ounces

Mix dry and sprinkle around where the flies can get it.

Non-Poisonous Fly-Papers.—I.—Mix 25 parts of quassia decoction (1:10) with 6 parts of brown sugar and 3 parts of ground pepper, and place on flat dishes.

II.—Mix 1 part of ground pepper and 1 part of brown sugar with 16 parts milk

or cream, and put the mixture on flat plates.

III.—Macerate 20 parts of quassia wood with 100 parts of water for 24 hours, boil one-half hour, and squeeze off 24 hours. The liquid is mixed with 3 parts of molasses, and evaporated to 10 parts. Next add 1 part of alcohol. Soak blotting paper with this mixture, and put on plates.

IV.—Dissolve 5 parts of potassium bichromate, 15 parts of sugar, and 1 part of essential pepper oil in 60 parts of water, and add 10 parts of alcohol. Saturate unsized paper with this solution and dry well.

V.—Boil together for half an hour

Ground quassia	
wood.....	18 pounds
Broken colocynth..	3 pounds
Ground long pepper.....	5 pounds
Water.....	80 pounds

Then percolate and make up to 60 pounds if necessary with more water. Then add 4 pounds of syrup. Unsized paper is soaked in this, and dried as quickly as possible to prevent it from getting sour.

VI.—Mix together

Ordinary syrup....	100 ounces
Honey.....	30 ounces
Extract of quassia	
wood.....	4 ounces
Oil of aniseed, a few drops.	

Removing the Gum of Sticky Fly-Paper.—The "gum" of sticky fly-paper that has "leaked" over furniture and shelfware can be removed without causing injury to either furniture or bottles.

The "gum" of sticky fly-paper, while being quite adhesive, is easily dissolved with alcohol (grain or wood) or oil of turpentine. Alcohol will not injure the shelfware, but it should not be used on varnished furniture; in the latter case turpentine should be used.

FLY PROTECTIVES FOR ANIMALS:

See Insecticides.

FOAM PREPARATIONS.

A harmless gum cream is the following:

I.—Digest 100 parts of Panama wood for 8 days with 400 parts of water and 100 parts of spirits of wine (90 per cent). Pour off without strong pressure and filter.

For every 5 parts of lemonade syrup take 5 parts of this extract, whereby a

magnificent, always uniform foam is obtained on the lemonade.

II.—Heat 200 parts of quillaia bark with distilled water during an hour in a vapor bath, with frequent stirring, and squeeze out. Thin with water if necessary and filter.

FOOD ADULTERANTS, SIMPLE TESTS FOR THEIR DETECTION.

Abstract of a monograph by W. D. Bigelow and Burton J. Howard, published by the Department of Agriculture.

Generally speaking, the methods of chemical analysis employed in food laboratories can be manipulated only by one who has had at least the usual college course in chemistry, and some special training in the examination of foods is almost as necessary. Again, most of the apparatus and chemicals necessary are entirely beyond the reach of the home, and the time consumed by the ordinary examination of a food is in itself prohibitive.

Yet there are some simple tests which serve to point out certain forms of adulteration and can be employed by the careful housewife with the reagents in her medicine closet and the apparatus in her kitchen. The number may be greatly extended by the purchase of a very few articles that may be procured for a few cents at any drug store. In applying these tests, one general rule must always be kept carefully in mind. Every one, whether layman or chemist, must familiarize himself with a reaction before drawing any conclusions from it. For instance, before testing a sample of supposed coffee for starch, the method should be applied to a sample of pure coffee (which can always be procured unground) and to a mixture of pure coffee and starch prepared by the operator.

Many manufacturers and dealers in foods have the ordinary senses so highly developed that by their aid alone they can form an intelligent opinion of the nature of a product, or of the character, and sometimes even of the proportion of adulterants present. This is especially true of such articles as coffee, wine, salad oils, flavoring extracts, butter, and milk. The housewife finds herself constantly submitting her purchases to this test. Her broad experience develops her senses of taste and smell to a high degree, and her discrimination is often sharper and more accurate than she herself realizes. The manufacturer who has developed his natural senses most

highly appreciates best the assistance or collaboration of the chemist, who can often come to his relief when his own powers do not avail. So the housewife, by a few simple chemical tests, can broaden her field of vision and detect many impurities that are not evident to the senses.

There are here given methods adapted to this purpose, which may be applied to milk, butter, coffee, spices, olive oil, vinegar, jams and jellies, and flavoring extracts. In addition to this some general methods for the detection of coloring matter and preservatives will be given. All of the tests here described may be performed with utensils found in any well-appointed kitchen. It will be convenient, however, to secure a small glass funnel, about 3 inches in diameter, since filtration is directed in a number of the methods prescribed. Filter paper can best be prepared for the funnel by cutting a circular piece about the proper size and folding it once through the middle, and then again at right angles to the first fold. The paper may then be opened without unfolding in such a way that three thicknesses lie together on one side and only one thickness on the other. In this way the paper may be made to fit nicely into the funnel.

Some additional apparatus, such as test tubes, racks for supporting them, and glass rods, will be found more convenient for one who desires to do considerable work on this subject, but can be dispensed with. The most convenient size for test tubes is a diameter of from $\frac{1}{2}$ to $\frac{3}{4}$ inch, and a length of from 5 to 6 inches. A graduated cylinder will also be found very convenient. If this is graduated according to the metric system, a cylinder containing about 100 cubic centimeters will be found to be convenient; if the English liquid measure is used it may be graduated to from 3 to 8 ounces.

Chemical Reagents.—The word "reagent" is applied to "any substance used to effect chemical change in another substance for the purpose of identifying its component parts or determining its percentage composition." The following reagents are required in the methods here given:

Turmeric paper.
Iron alum (crystal or powdered form).
Hydrochloric acid (muriatic acid), concentrated.

Caution.—All tests in which hydrochloric acid is used should be conducted in glass or earthenware, for this acid at-

tacks and will injure metal vessels. Care must also be taken not to bring it into contact with the flesh or clothes. If, by accident, a drop of it falls upon the clothes, ammonia, or in its absence a solution of saleratus or sal soda (washing soda), in water, should be applied promptly.

Iodine tincture.

Potassium permanganate, 1 per cent solution.

Alcohol (grain alcohol).

Chloroform.

Boric acid or borax.

Ammonia water.

Halphen's reagent.

With the exception of the last reagent mentioned, these substances may be obtained in any pharmacy. The Halphen reagent should be prepared by a druggist, certainly not by an inexperienced person.

It is prepared as follows: An approximately 1 per cent solution of sulphur is made by dissolving about $\frac{1}{2}$ of a teaspoonful of precipitated sulphur in 3 or 4 ounces of carbon bisulphide. This solution mixed with an equal volume of amyl alcohol forms the reagent required by the method. A smaller quantity than that indicated by these directions may, of course, be prepared.

If turmeric paper be not available it may be made as follows: Place a bit of turmeric powder (obtainable at any drug store) in alcohol, allow it to stand for a few minutes, stir, allow it to stand again until it settles, dip a strip of filter paper into the solution, and dry it.

Determination of Preservatives.—The following methods cover all of the more important commercial preservatives with the exception of sulphites and fluorides. These are quite frequently used for preserving foods—the former with meat products and the latter with fruit products—but, unfortunately, the methods for their detection are not suitable for household use.

Detection of Salicylic Acid.—The determination of salicylic acid can best be made with liquids. Solid and semi-solid foods, such as jelly, should be dissolved, when soluble, in sufficient water to make them thinly liquid. Foods containing insoluble matter, such as jam, marmalade, and sausage, may be macerated with water and strained through a piece of white cotton cloth. The maceration may be performed by rubbing in a teacup or other convenient vessel with a heavy spoon.

Salicylic acid is used for preserving

fruit products of all kinds, including beverages. It is frequently sold by drug stores as fruit acid. Preserving powders consisting entirely of salicylic acid are often carried from house to house by agents. It may be detected as follows:

Between 2 and 3 ounces of the liquid obtained from the fruit products, as described above, are placed in a narrow bottle holding 5 ounces, about a quarter of a teaspoonful of cream of tartar (or, better, a few drops of sulphuric acid) is added, the mixture shaken for 2 or 3 minutes, and filtered into a second small bottle. Three or 4 tablespoonfuls of chloroform are added to the clear liquid in the second bottle and the liquids mixed by a somewhat vigorous rotary motion, poured into an ordinary glass tumbler, and allowed to stand till the chloroform settles out in the bottom. Shaking is avoided, as it causes an emulsion which is difficult to break up. As much as possible of the chloroform layer (which now contains the salicylic acid) is removed (without any admixture of the aqueous liquid) by means of a medicine dropper and placed in a test tube or small bottle with about an equal amount of water and a small fragment—a little larger than a pinhead—of iron alum. The mixture is thoroughly shaken and allowed to stand till the chloroform again settles to the bottom. The presence of salicylic acid is then indicated by the purple color of the upper layer of liquid.

Detection of Benzoic Acid.—Benzoic acid is also used for preserving fruit products. Extract the sample with chloroform as in the case of salicylic acid; remove the chloroform layer and place it in a white saucer, or, better, in a plain glass sauce dish. Set a basin of water—as warm as the hand can bear—on the outside window ledge and place the dish containing the chloroform extract in it, closing the window until the chloroform has completely evaporated. In this manner the operation may be conducted with safety even by one who is not accustomed to handling chloroform. In warm weather the vessel of warm water may, of course, be omitted. Benzoic acid, if present in considerable amount, will now appear in the dish in characteristic flat crystals. On warming the dish the unmistakable irritating odor of benzoic acid may be obtained. This method will detect benzoic acid in tomato catsup or other articles in which it is used in large quantities. It is not sufficiently delicate, however, for the smaller amount used with some articles, such as

wine. It is often convenient to extract a larger quantity of the sample and divide the chloroform layer into two portions, testing one for salicylic acid and the other for benzoic acid.

Detection of Boric Acid and Borax.—Boric acid (also called boracic acid) and its compound with sodium (borax) are often used to preserve animal products, such as sausage, butter, and sometimes milk. For the detection of boric acid and borax, solids should be macerated with a small amount of water and strained through a white cotton cloth. The liquid obtained by treating solids in this manner is clarified somewhat by thoroughly chilling and filtering through filter paper.

In testing butter place a heaping teaspoonful of the sample in a teacup, add a couple of teaspoonfuls of hot water, and stand the cup in a vessel containing a little hot water until the butter is thoroughly melted. Mix the contents of the cup well by stirring with a teaspoon and set the cup with the spoon in it in a cold place until the butter is solid. The spoon with the butter (which adheres to it) is now removed from the cup and the turbid liquid remaining strained through a white cotton cloth, or, better, through filter paper. The liquid will not all pass through the cloth or filter paper, but a sufficient amount for the test may be secured readily.

In testing milk for boric acid 2 or 3 tablespoonfuls of milk are placed in a bottle with twice that amount of a solution of a teaspoonful of alum in a pint of water, shaken vigorously, and filtered through filter paper. Here again a clear or only slightly turbid liquid passes through the paper.

About a teaspoonful of the liquid obtained by any one of the methods mentioned above is placed in any dish, not metal, and 5 drops of hydrochloric (muriatic) acid added. A strip of turmeric paper is dipped into the liquid and then held in a warm place—near a stove or lamp—till dry. If boric acid or borax was present in the sample the turmeric paper becomes bright cherry red when dry. A drop of household ammonia changes the red color to dark green or greenish black. If too much hydrochloric acid is used the turmeric paper may take on a brownish-red color even in the absence of boric acid. In this case, however, ammonia changes the color to brown just as it does turmeric paper which has not been dipped into the acid solution.

Detection of Formaldehyde.—Formaldehyde is rarely used with other foods than milk. The method for its detection in milk is given later. For its detection in other foods it is usually necessary first to separate it by distillation, a process which is scarcely available for the average person without laboratory training and special apparatus. For this reason no method is suggested here for the detection of formaldehyde in other foods than milk.

Detection of Saccharine.—Saccharine has a certain preservative power, but it is used not so much for this effect as because of the very sweet taste which it imparts. It is extracted by means of chloroform, as described under the detection of salicylic acid. In the case of solid and semi-solid foods, the sample must, of course, be prepared by extraction with water, as described under salicylic acid. The residue left after the evaporation of the chloroform, if a considerable amount of saccharine is present, has a distinctly sweet taste.

The only other substance having a sweet taste which may be present in foods, i. e., sugar, is not soluble in chloroform, and therefore does not interfere with this reaction. Certain other bodies (tannins) which have an astringent taste are present, and as they are soluble in chloroform may sometimes mask the test for saccharine, but with practice this difficulty is obviated.

Determination of Artificial Colors:

Detection of Coal-Tar Dyes.—Coloring matters used with foods are usually soluble in water. If the food under examination be a liquid, it may therefore be treated directly by the method given below. If it be a solid or a pasty substance, soluble in water either in the cold or after heating, it may be dissolved in sufficient water to form a thin liquid. If it contains some insoluble material, it may be treated with sufficient water to dissolve the soluble portion with the formation of a thin liquid and filtered, and then strained through a clean white cotton cloth to separate the insoluble portion. About a half teacupful of the liquid thus described is heated to boiling, after adding a few drops of hydrochloric acid and a small piece of white woolen cloth or a few strands of white woolen yarn. (Before using, the wool should be boiled with water containing a little soda, to remove any fat it may contain, and then washed with water.) The wool is again washed, first with hot and then

with cold water, the water pressed out as completely as possible, and the color of the fabric noted. If no marked color is produced, the test may be discontinued and the product considered free from artificial colors. If the fabric is colored, it may have taken up coal-tar colors, some foreign vegetable colors, and if a fruit product is being examined, some of the natural coloring matter of the fruit. Rinse the fabric in hot water, and then boil for 2 or 3 minutes in about one-third of a teacupful of water and 2 or 3 teaspoonfuls of household ammonia. Remove and free from as much of the liquid as possible by squeezing or wringing. Usually the fabric will retain the greater part of the natural fruit color, while the coal-tar color dissolves in dilute ammonia. The liquid is then stirred with a splinter of wood and hydrochloric acid added, a drop or two at a time, until there is no longer any odor of ammonia. (The atmosphere of the vessel is sometimes charged with the ammonia for several minutes after it has all been driven out of the liquid; therefore one should blow into the dish to remove this air before deciding whether the ammonia odor has been removed or not.) When enough acid has been added the liquid has a sour taste, as may be determined by touching the splinter, used in stirring, to the tongue.

A fresh piece of white woolen cloth is boiled in this liquid and thoroughly washed. If this piece of cloth has a distinct color the food under examination is artificially colored. The color used may have been a coal-tar derivative, commonly called an aniline dye, or an artificial color chemically prepared from some vegetable color. If of the first class the dyed fabric is usually turned purple or blue by ammonia. In either case, if the second fabric has a distinct color, it is evident that the product under examination is artificially colored. Of course a dull, faint tint must be disregarded.

Detection of Copper.—The presence of copper, often used to deepen the green tint of imported canned peas, beans, spinach, etc., may be detected as follows: Mash some of the sample in a dish with a stiff kitchen spoon. Place a teaspoonful of the pulp in a teacup with 3 teaspoonfuls of water and add 30 drops of strong hydrochloric acid with a medicine dropper. Set the cup on the stove in a saucepan containing boiling water. Drop a bright iron brad or nail (wire nails are the best and tin carpet tacks

will not answer the purpose) into the cup and keep the water in the saucepan boiling for 20 minutes, stirring the contents of the cup frequently with a splinter of wood. Pour out the contents of the cup and examine the nail. If present in an appreciable amount the nail will be heavily plated with copper.

Caution.—Be careful not to allow the hydrochloric acid to come in contact with metals or with the flesh or clothing.

Detection of Turmeric.—In yellow spices, especially mustard and mace, turmeric is often employed. This is especially true of prepared mustard to which a sufficient amount of starch adulterant has been added to reduce the natural color materially. If turmeric be employed to restore the normal shade an indication of that fact may sometimes be obtained by mixing a half teaspoonful of the sample in a white china dish and mixing with it an equal amount of water, and a few drops (4 to 10) of household ammonia, when a marked brown color, which does not appear in the absence of turmeric, is formed. At the present time turmeric or a solution of curcuma (the coloring matter of turmeric) is sometimes added to adulterated mustard in sufficient amount to increase its color, but not to a sufficient extent to give the brown appearance with ammonia described above. In such cases a teaspoonful of the suspected sample may be thoroughly stirred with a couple of tablespoonfuls of alcohol, the mixture allowed to settle for 15 minutes or more, and the upper liquid poured off into a clean glass or bottle. To about 1 tablespoonful of the liquid thus prepared and placed in a small, clear dish (a glass salt cellar serves excellently) add 4 or 5 drops of a concentrated solution of boric acid or borax and about 10 drops of hydrochloric acid, and mix the solution by stirring with a splinter of wood. A wedge-shaped strip of filter paper, about 2 or 3 inches long, 1 inch wide at the upper end, and $\frac{1}{2}$ inch at the lower end, is then suspended by pinning, so that its narrow end is immersed in the solution, and is allowed to stand for a couple of hours. The best results are obtained if the paper is so suspended that air can circulate freely around it, i. e., not allowing it to touch anything except the pin and the liquid in the dish. If turmeric be present a cherry-red color forms on the filter paper a short distance below the upper limit to which the liquid is absorbed by the paper, frequently from $\frac{1}{4}$ of an inch to an inch above the surface

of the liquid itself. A drop of household ammonia changes this red color to a dark green, almost black. If too much hydrochloric acid is used a dirty brownish color is produced.

Detection of Caramel.—A solution of caramel is used to color many substances, such as vinegar and some distilled liquors. To detect it two test tubes or small bottles of about equal size and shape should be employed and an equal amount (2 or 3 tablespoonfuls or more) of the suspected sample placed in each. To one of these bottles is added a teaspoonful of fuller's earth, the sample shaken vigorously for 2 or 3 minutes, and then filtered through filter paper, the first portion of the filtered liquid being returned to the filter paper and the sample finally collected into the test tube or bottle in which it was originally placed, or a similar one. The filtered liquid is now compared with the untreated sample. If it is markedly lighter in color it may be taken for granted that the color of the liquid is due to caramel, which is largely removed by fuller's earth. In applying this test, however, it must be borne in mind that caramel occurs naturally in malt vinegar, being formed in the preparation of the malt. It is evident that the tests require practice and experience before they can be successfully performed. The housewife can use them, but must repeat them frequently in order to become proficient in their use.

EXAMINATION OF CERTAIN CLASSES OF FOODS:

Canned Vegetables.—These are relatively free from adulteration by means of foreign substances. The different grades of products may with care be readily detected by the general appearance of the sample. The purchaser is, of course, at the disadvantage of not being able to see the product until the can is opened. By a study of the different brands available in the vicinity, however, he can readily select those which are preferable. As stated in an earlier part of this article, canned tomatoes sometimes contain an artificial coloring matter, which may be detected as described.

Canned sweet corn is sometimes sweetened with saccharine, which may be detected as described.

It is believed that, as a rule, canned vegetables are free from preservatives, although some instances of chemical preservation have recently been reported in North Dakota, and some imported

tomatoes have been found to be artificially preserved. The presence of copper, often used for the artificial greening of imported canned peas, beans, spinach, etc., may be detected as described.

Coffee.—There are a number of simple tests for the presence of the adulterants of ground coffee. These are called simple because they can be performed without the facilities of the chemical laboratory, and by one who has not had the experience and training of a chemist. It must be understood that they require careful observation and study, and that one must perform them repeatedly in order to obtain reliable results. Before applying them to the examination of an unknown sample, samples of known character should be secured and studied. Unground coffee may be ground in the home and mixed with various kinds of adulterants, which can also be secured separately. Thus the articles themselves in known mixtures may be studied, and when the same results are obtained with unknown samples they can be correctly interpreted. These tests are well known in the laboratory and may be used in the home of the careful housewife who has the time and perseverance to master them.

Physical Tests.—The difference between the genuine ground coffee and the adulterated article can often be detected by simple inspection with the naked eye. This is particularly true if the product be coarsely crushed rather than finely ground. In such condition pure coffee has a quite uniform appearance, whereas the mixtures of peas, beans, cereals, chicory, etc., often disclose their heterogeneous nature to the careful observer. This is particularly true if a magnifying glass be employed. The different articles composing the mixture may then be separated by the point of a pen-knife. The dark, gummy-looking chicory particles stand out in strong contrast to the other substances used, and their nature can be determined by one who is familiar with them by their astringent taste.

The appearance of the coffee particles is also quite distinct from that of many of the coffee substitutes employed. The coffee has a dull surface, whereas some of its substitutes, especially leguminous products, often present the appearance of having a polished surface.

After a careful inspection of the sample with the naked eye, or, better, with a magnifying glass, a portion of it may be placed in a small bottle half full of water and shaken. The bottle is then placed

on the table for a moment. Pure coffee contains a large amount of oil, by reason of which the greater portion of the sample will float. All coffee substitutes and some particles of coffee sink to the bottom of the liquid. A fair idea of the purity of the sample can often be determined by the proportion of the sample which floats or sinks.

Chicory contains a substance which dissolves in water, imparting a brownish-red color. When the suspected sample is dropped into a glass of water, the grains of chicory which it contains may be seen slowly sinking to the bottom, leaving a train of a dark-brown colored liquid behind them. This test appears to lead to more errors in the hands of inexperienced operators than any other test here given. Wrong conclusions may be avoided by working first with known samples of coffee and chicory as suggested above.

Many coffee substitutes are now sold as such and are advertised as more wholesome than coffee. Notwithstanding the claims that are made for them, a few of them contain a considerable percentage of coffee. This may be determined by shaking a teaspoonful in a bottle half full of water, as described above. The bottle must be thoroughly shaken so as to wet every particle of the sample. Few particles of coffee substitutes will float.

Chemical Tests.—Coffee contains no starch, while all of the substances, except chicory, used for its adulteration and in the preparation of coffee substitutes contain a considerable amount of starch. The presence of such substitutes may, therefore, be detected by applying the test for starch. In making this test less than a quarter of a teaspoonful of ground coffee should be used, or a portion of the ordinary infusion prepared for the table may be employed after dilution. The amount of water that should be added can only be determined by experience.

Condimental Sauces.—Tomato catsup and other condimental sauces are frequently preserved and colored artificially. The preservatives employed are usually salicylic acid and benzoic acid or their sodium salts. These products may be detected by the methods given. Coal-tar colors are frequently employed with this class of goods, especially with those of a reddish tint, like tomato catsup. They may be detected by the methods given.

DAIRY PRODUCTS:

Butter.—Methods are available which, with a little practice, may be employed to distinguish between fresh butter, renovated or process butter, and oleomargarine.

These methods are commonly used in food and dairy laboratories. They give reliable results. At the same time considerable practice is necessary before we can interpret correctly the results obtained. Some process butters are on the market which can be distinguished from fresh butter only with extreme difficulty. During the last few years considerable progress has been made in the attempt to renovate butter in such a way that it will appear like fresh butter in all respects. A study must be made of these methods if we would obtain reliable results.

The "spoon" test has been suggested as a household test, and is commonly used by analytical chemists for distinguishing fresh butter from renovated butter and oleomargarine. A lump of butter, 2 or 3 times the size of a pea, is placed in a large spoon and heated over an alcohol or Bunsen burner. If more convenient the spoon may be held above the chimney of an ordinary kerosene lamp, or it may even be held over an ordinary illuminating gas burner. If the sample in question be fresh butter it will boil quietly, with the evolution of many small bubbles throughout the mass which produce a large amount of foam. Oleomargarine and process butter, on the other hand, sputter and crackle, making a noise similar to that heard when a green stick is placed in a fire. Another point of distinction is noted if a small portion of the sample be placed in a small bottle and set in a vessel of water sufficiently warm to melt the butter. The sample is kept melted from half an hour to an hour, when it is examined. If renovated butter or oleomargarine, the fat will be turbid, while if genuine fresh butter the fat will almost certainly be entirely clear.

To manipulate what is known as the "Waterhouse" or "milk" test, about 2 ounces of sweet milk are placed in a wide-mouthed bottle, which is set in a vessel of boiling water. When the milk is thoroughly heated, a teaspoonful of butter is added, and the mixture stirred with a splinter of wood until the fat is melted. The bottle is then placed in a dish of ice water and the stirring continued until the fat solidifies. If the sample be butter, either fresh or renovated, it will be solidified in a granular

condition and distributed through the milk in small particles. If, on the other hand, the sample consist of oleomargarine it solidifies practically in one piece and may be lifted by the stirrer from the milk.

By these two tests, the first of which distinguishes fresh butter from process or renovated butter and oleomargarine, and the second of which distinguishes oleomargarine from either fresh butter or renovated butter, the nature of the sample under examination may be determined.

Milk.—The oldest and simplest method of adulterating milk is by dilution with water. This destroys the natural yellowish-white color and produces a bluish tint, which is sometimes corrected by the addition of a small amount of coloring matter.

Another form of adulteration is the removal of the cream and the sale as whole milk of skimmed or partially skimmed milk. Again, the difficulty experienced in the preservation of milk in warm weather has led to the widespread use of chemical preservatives.

Detection of Water.—If a lactometer or hydrometer, which can be obtained of dealers in chemical apparatus, be available, the specific gravity of milk will afford some clew as to whether the sample has been adulterated by dilution with water. Whole milk has a specific gravity between 1.027 and 1.033. The specific gravity of skimmed milk is higher, and milk very rich in cream is sometimes lower than these figures. It is understood, of course, that by specific gravity is meant the weight of a substance with reference to the weight of an equal volume of water. The specific gravity of water is 1. It is obvious that if water be added to a milk with the specific gravity of 1.030, the specific gravity of the mixture will be somewhat below those figures.

An indication by means of a hydrometer or lactometer below the figure 1.027 therefore indicates either that the sample in question is a very rich milk or that it is a milk (perhaps normal, perhaps skimmed) that has been watered. The difference in appearance and nature of these two extremes is sufficiently obvious to make use of the lactometer or hydrometer of value as a preliminary test of the purity of milk.

Detection of Color.—As previously stated, when milk is diluted by means of water the natural yellowish-white color is changed to a bluish tint, which is sometimes corrected by the addition

of coloring matter. Coal-tar colors are usually employed for this purpose. A reaction for these colors is often obtained in the method given below for the detection of formaldehyde. When strong hydrochloric acid is added to the milk in approximately equal proportions before the mixture is heated a pink tinge sometimes is evident if a coal-tar color has been added.

Detection of Formaldehyde.—Formaldehyde is the substance most commonly used for preserving milk and is rarely, if ever, added to any other food. Its use is inexcusable and especially objectionable in milk served to infants and invalids.

To detect formaldehyde in milk 3 or 4 tablespoonfuls of the sample are placed in a teacup with at least an equal amount of strong hydrochloric acid and a piece of ferric alum about as large as a pin-head, the liquids being mixed by a gentle rotary motion. The cup is then placed in a vessel of boiling water, no further heat being applied, and left for 5 minutes. At the end of this time, if formaldehyde be present, the mixture will be distinctly purple. If too much heat is applied, a muddy appearance is imparted to the contents of the cup.

Caution.—Great care must be exercised in working with hydrochloric acid, as it is strongly corrosive.

Edible Oils.—With the exception of cottonseed oil, the adulterants ordinarily used with edible oils are of such a nature that the experience of a chemist and the facilities of a chemical laboratory are essential to their detection. There is, however, a simple test for the detection of cottonseed oil, known as the Halphen test, which may be readily applied.

Great care must be taken in the manipulation of this test, as one of the reagents employed—carbon bisulphide—is very inflammable. The chemicals employed in the preparation of the reagent used for this test are not household articles. They may, however, be obtained in any pharmacy. The mixture should be prepared by a druggist rather than by an inexperienced person who desires to use it.

In order to perform the test 2 or 3 tablespoonfuls of this reagent are mixed in a bottle with an equal volume of the suspected sample of oil and heated in a vessel of boiling salt solution (prepared by dissolving 1 tablespoonful of salt in a pint of water) for 10 or 15 minutes. At the end of that time, if even a small percentage of cottonseed oil be present, the

mixture will be of a distinct reddish color, and if the sample consists largely or entirely of cottonseed oil, the color will be deep red.

Eggs.—There is no better method for the testing of the freshness of an egg than the familiar one of "candling," which has long been practiced by dealers. The room is darkened and the egg held between the eye and a light; the presence of dark spots indicates that the egg is not perfectly fresh, one that is fresh presenting a homogeneous, translucent appearance. Moreover, there is found in the larger end of a fresh egg, between the shell and the lining membrane, a small air cell which, of course, is distinctly transparent. In an egg which is not perfectly fresh this space is filled and hence presents the same appearance as the rest of the egg.

It is now a matter of considerable importance to be able to distinguish between fresh eggs and those that have been packed for a considerable time. Until recently that was not a difficult matter. All of the solutions that were formerly extensively used for that purpose gave the shell a smooth, glistening appearance which is not found in the fresh egg. This characteristic, however, is of less value now than formerly, owing to the fact that packed eggs are usually preserved in cold storage. There is now no means by which a fresh egg can be distinguished from a packed egg without breaking it. Usually in eggs that have been packed for a considerable time the white and yolk slightly intermingle along the point of contact, and it is a difficult matter to separate them. Packed eggs also have a tendency to adhere to the shell on one side and when opened frequently have a musty odor.

FLAVORING EXTRACTS.

Although a large number of flavoring extracts are on the market, vanilla and lemon extracts are used so much more commonly than other flavors that a knowledge of their purity is of the greatest importance. Only methods for the examination of those two products will be considered.

Vanilla Extract.—Vanilla extract is made by extracting vanilla beans with alcohol. It consists of an alcoholic solution of vanillin (the characteristic flavoring matter of the vanilla bean) and several other products, chiefly resins, which, though present in but small amount and having only a slight flavor in themselves, yet affect very materially

the flavor of the product. Vanilla extract is sometimes adulterated with the extract of the Tonka bean. This extract, to a certain extent, resembles vanilla extract. The extract of the Tonka bean, however, is far inferior to that of the vanilla bean. It has a relatively penetrating, almost pungent odor, standing in sharp contrast to the flavor of the vanilla extract. This odor is so different that one who has given the matter some attention may readily distinguish the two, and the quality of the vanilla extract may often be judged with a fair degree of accuracy by means of the odor alone.

Another form of adulteration, and one that is now quite prevalent, is the use of artificial vanillin in place of the extract of either vanilla or Tonka beans. Artificial vanillin has, of course, the same composition and characteristics as the natural vanillin of the vanilla bean. Extracts made from it, however, are deficient in the rosins and other products which are just as essential to the true vanilla, as is vanillin itself. Since vanillin is thus obtained from another source so readily, methods for the determination of the purity of vanilla extract must depend upon the presence of other substances than vanillin.

Detection of Caramel.—The coloring matter of vanilla extract is due to substances naturally present in the vanilla bean and extracted therefrom by alcohol. Artificial extracts made by dissolving artificial vanillin in alcohol contain no color of themselves, and to supply it caramel is commonly employed. Caramel may be detected in artificial extracts by shaking and observing the color of the resulting foam after a moment's standing. The foam of pure extracts is colorless. If caramel is present a color persists at the points of contact between the bubbles until the last bubble has disappeared. The test with fuller's earth given for caramel in vinegar is also very satisfactory, but of course requires the loss of the sample used for the test.

Examination of the Rosin.—If pure vanilla extract be evaporated to about one-third its volume the rosins become insoluble and settle to the bottom of the dish. Artificial extracts remain clear under the same conditions. In examining vanilla extract the character of these rosins is studied. For this purpose a dish containing about an ounce of the extract is placed on a teakettle or other vessel of boiling water until the liquid

evaporates to about one-third or less of its volume. Owing to the evaporation of the alcohol the rosins will then be insoluble. Water may be added to restore the liquid to approximately its original volume. The rosin will then separate out as a brown flocculent precipitate. A few drops of hydrochloric acid may be added and the liquid stirred and the insoluble matter allowed to settle. It is then filtered and the rosin on the filter paper washed with water. The rosin is then dissolved in a little alcohol, and to 1 portion of this solution is added a small particle of ferric alum, and to another portion a few drops of hydrochloric acid. If the rosin be that of the vanilla bean, neither ferric alum nor hydrochloric acid will produce more than a slight change of color. With rosins from most other sources, however, one or both of these substances yield a distinct color change.

For filtering, a piece of filter paper should be folded once through the middle and again at right angles to the first fold. It may now be opened with one fold on one side and three on the other and fitted into a glass funnel. When the paper is folded in this manner the precipitated rosins may be readily washed with water. When the washing is completed the rosins may be dissolved by pouring alcohol through the filter. This work with the rosins will require some practice before it can be successfully performed. It is of considerable value, however, in judging of the purity of vanilla extract.

Lemon Extract.—By lemon extract is understood a solution of lemon oil in strong alcohol. In order to contain as much lemon oil as is supposed to be found in high-grade extracts the alcohol should constitute about 80 per cent of the sample. The alcohol is therefore the most valuable constituent of lemon extract, and manufacturers who turn out a low-grade product usually do so because of their economy of alcohol rather than of lemon oil. Owing to the fact that lemon extract is practically a saturated solution of oil of lemon in strong alcohol the sample may be examined by simple dilution with water. A teaspoonful of the oil in question may be placed in the bottom of an ordinary glass tumbler and 2 or 3 teaspoonfuls of water added. If the sample in question be real lemon extract the lemon oil should be thrown out of solution by reason of its insolubility in the alcohol after its dilution with water. The result is at first a marked turbidity and later the separation of the oil of lemon on the top

of the aqueous liquid. If the sample remains perfectly clear after the addition of water, or if a marked turbidity is not produced, it is a low-grade product and contains very little, if any, oil of lemon.

Fruit Products.—Adulteration of fruit products is practically confined to jellies and jams. Contrary to the general belief, gelatin is never used in making fruit jelly. In the manufacture of the very cheapest grade of jellies starch is sometimes employed. Jellies containing starch, however, are so crude in their appearance that the most superficial inspection is sufficient to demonstrate that they are not pure fruit jellies. From their appearance no one would think it worth while to examine them to determine their purity.

Natural fruit jellies become liquid on being warmed. A spoonful dissolves readily in warm water, although considerable time is required with those that are especially firm. The small fruits contain practically no starch, as apples do, and the presence of starch in a jelly indicates that some apple juice has probably been used in its preparation.

Detection of Starch.—Dissolve a teaspoonful of jelly in a half teacupful of hot water, heat to boiling and add, drop by drop, while stirring with a teaspoon, a solution of potassium permanganate until the solution is almost colorless. Then allow the solution to cool and test for starch with tincture of iodine, as directed later. Artificially colored jellies are sometimes not decolorized by potassium permanganate. Even without decolorizing, however, the blue color can usually be seen.

Detection of Glucose.—For the detection of glucose, a teaspoonful of the jelly may be dissolved in a glass tumbler or bottle in 2 or 3 tablespoonfuls of water. The vessel in which the jelly is dissolved may be placed in hot water if necessary to hasten the solution. In case a jam or marmalade is being examined, the mixture is filtered to separate the insoluble matter. The solution is allowed to cool, and an equal volume or a little more of strong alcohol is added. If the sample is a pure fruit product the addition of alcohol causes no precipitation, except that a very slight amount of proteid bodies is thrown down. If glucose has been employed in its manufacture, however, a dense white precipitate separates and, after a time, settles to the bottom of the liquid.

Detection of Foreign Seeds.—In addition to the forms of adulteration to which jellies are subject, jams are sometimes manufactured from the exhausted fruit pulp left after removing the juice for making jelly. When this is done residues from different fruits are sometimes mixed. Exhausted raspberry or blackberry pulp may be used in making "strawberry" jam and *vice versa*. Some instances are reported of various small seeds, such as timothy, clover, and alfalfa seed, having been used with jams made from seedless pulp.

With the aid of a small magnifying glass such forms of adulteration may be detected, the observer familiarizing himself with the seeds of the ordinary fruits.

Detection of Preservatives and Colors.—With jellies and jams salicylic and benzoic acids are sometimes employed. They may be detected by the methods given.

Artificial colors, usually coal-tar derivatives, are sometimes used and may be detected as described.

Meat Products.—As in many other classes of foods, certain questions important in the judgment of meats require practical experience and close observation rather than chemical training. This is especially true of meat products. The general appearance of the meat must largely guide the purchaser. If, however, the meat has been treated with preservatives and coloring matter its appearance is so changed as to deceive him. The preservatives employed with meat products are boric acid, borax, and sulphites. The methods for the detection of sulphites are not suitable for household use.

Detection of Boric Acid and Borax.—To detect boric acid (if borax has been used the same reaction will be obtained), about a tablespoonful of the chopped meat is thoroughly macerated with a little hot water, pressed through a bag, and 2 or 3 tablespoonfuls of the liquid placed in a sauce dish with 15 or 20 drops of strong hydrochloric acid for each tablespoonful. The liquid is then filtered through filter paper, and a piece of turmeric paper dipped into it and dried near a lamp or stove. If boric acid or borax were used for preserving the sample, the turmeric paper should be changed to a bright cherry-red color. If too much hydrochloric acid has been employed a dirty brownish-red color is obtained, which interferes with the color due to the presence of